Signal Intensity profile comparison of two different QD surface coils

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Introduction

Surface coils have higher signal-to-noise ratio(SNR) than volume coils because they receive noises only from nearby regions. Also, quadrature (QD) or circularly polarized (CP) surface coil can improve (SNR) by a factor of root mean square compared to surface coils that used for linear polarized[1,2]. This is because two orthogonal coils can generate and receive circularly polarized B_1 field. Also, the profile of B_1 field generated by QD surface coils depend on geometry of coil. Nevertheless, no comparisonal analysis for B_1 field uniformity among various types of coil geometry was reported. In this study, QD surface coils such as two single (TS) coil and combination of single loop Helmholtz (SH) coil were compared in terms of signal intensity profiles at 1.5T.

Methods

Two types of QD coils were built for this study as shown in Fig. 1. All experiments were performed in 1.5T MRI system (SIEMENS, Avanto system, Elargen, Germany). The coils were used in transmit/receive (Tx / Rx) mode with in-house QD coupler. Lumped element QD coupler provides a 3.3dB split with a 90° phase difference. The outer dimension of QD surface coils was 20cm x 20cm. The coils were constructed by etching flexible board material to improve durability and reproducibility and designed to minimize the inductive coupling between the elements. Gradient recalled echo (GRE) sequence was used and the parameters were TR / TE / FA = 200 ms / 3.5 ms / 20, BW = 260 Hz, slice thickness = 5 mm with 20% gap, FOV = 260 x 260 mm, matrix size = 384 x 512, and NEX = 1. The signal intensity profiles were obtained in coronal slices for evaluating the uniformity. A phantom with conductivity in 0.8S/m and permittivity in 78 was placed near the coils.

Results

Coronal GRE phantom images were acquired to compare signal intensity profiles. Fig. 2. shows coronal GRE phantom images acquired at different locations from QD surface coils. The signal intensity profiles were obtained at coronal slices as shown in Fig. 3. and normalized by maximum intensity values. To compare uniformity of two coils, we defined the uniform ranges as a width of which signal profile was over 80% of maximum intensity values. Uniform ranges of SH coil were 140mm at 24mm, 140mm at 36mm and 130mm at 48mm. The uniform ranges of TS coil were 46mm at 24mm, 64mm at 36mm and 100mm at 48mm. The uniform ranges of SH coil were broader than that of TS coil at 24mm, 36mm and 48mm locations. The uniform ranges of SH coil were varied within 10% whereas the ranges of TS coil were decreased to 50% as imaging slices closing to TS coil.

Conclusion

Experimental-based evaluations of signal intensity profiles of two QD surface coils have been performed and uniform ranges were compared. SH can provide more homogeneous signal intensity profiles in the region nearby coil compare to TS coil in coronal plane.

Reference [1] C,-N, Chen, et al., J. Magn. Reson. 54, 324-327(1983) [2] G. H. Glover, et al., J. Magn. Reson. 64.255-270(1985)

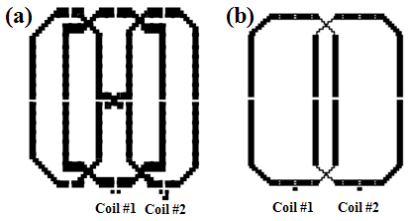

Fig. 1. QD surface of (a) SH and (b) TS coil

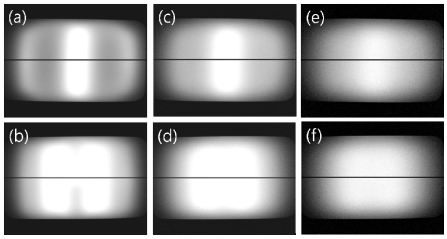

Fig. 2. GRE phantom coronal images. (a), (b) and (c) were obtained using TS coil. (b), (d) and (f) were SH coil. (a) and (b) slices located at 24mm from QD surface coil. (c) and (d) were 36mm. (e) and (f) were 48mm.

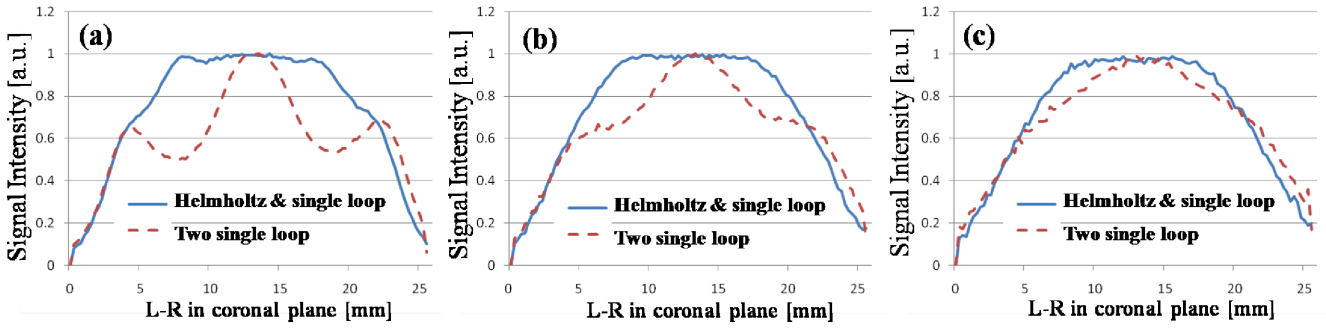

Fig. 3. Signal intensity profiles of GRE phantom images. (a) , (b) and (c) slices were located at 24mm, 36mm and 48mm from QD surface coils respectively.

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